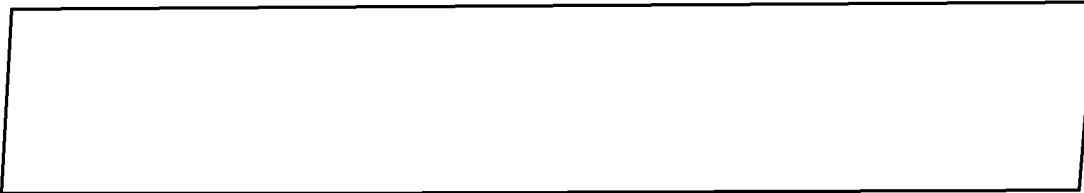


Mat. Br. Lockwood
300010018-2 E C P

LOCKHEED AIRCRAFT CORP.						ENGINEERING STUDY <input type="checkbox"/>															
						CHANGE PROPOSAL <input checked="" type="checkbox"/> -101															
DATE 1-16-61						AFFECTS : WSPO <input type="checkbox"/> PROJECT <input checked="" type="checkbox"/>															
NAME OF MAJOR COMPONENT AIRPLANE						PART OR LOWEST SUBASSEMBLY -----						PART NO. & MODEL OR TYPE -----									
TITLE OF PROPOSAL : ADDITION OF IN-FLIGHT REFUELING SYSTEM																					
NATURE OF PROPOSAL :																					
SEE PAGE 2																					
REASON FOR PROPOSAL :																					
To provide in-flight refueling capabilities on two U-2C aircraft per customer request. The proposed IFR configuration is based on design studies authorized by approved Change Proposal LAC-91.																					
ES		ESTIMATED COST AND TIME INVOLVED :																			
		ADDITIONAL FUNDING REQUIRED :																			
CP		ESTIMATED COST FOR KITS OR PARTS : See Page 4																			
		ADDITIONAL FUNDING REQUIRED : None (SP-1918 & SP-1917)																			
ITEMS AFFECTED BY PROPOSAL :																					
SAFETY		MISSION EFFEC. TIVENESS		PERFORM- ANCE		OPERATING PROCEDURE		INTER- CHANGE- ABILITY		WEIGHT OR WEIGHT & BALANCE		TOOLS & SUPPORT EQUIPMENT		MAINTENANCE PROCEDURE		SERVICE LIFE		FLIGHT MANUAL		MAINTENANCE MANUAL	
<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
EST. MAN/HRS. REQ'D. TO ACCOMPLISH CHANGE IN FIELD																					
SOURCE OF PARTS FOR KIT: LAC										AVAILABILITY --- WEEKS AFTER APPROVAL See Page 4 STA											
DISPOSITION OF SPARES AFFECTED None Approved for procurement of spares only her list on page 5.																					
INITIATED BY :										APPROVED : VIKOX											
PROJECT																					

NATURE OF PROPOSAL:

1. Develop and install an in-flight refueling system on two U-2C aircraft. The design to be based on use of the KC-135 tanker flying boom equipment, and to provide for refueling the main wing tanks only, utilizing a hydraulically extendable and retractable nozzle receptacle installed on the top centerline of the fuselage above the sump tanks. Refueling the main wing tanks requires modification of existing fuel system plumbing to feed from these tanks first. To maintain satisfactory flight characteristics for all fuel loadings with the revised "using" sequence, the zero fuel weight C.G. limits will be changed to approximately 26.0-26.5% MAC (actual limits to be determined by flight tests). The aircraft will be ballasted for the most forward loading condition to bring it within the above C.G. limits. This loading condition is assumed to be as follows:



All other load configurations will require a weight and balance check prior to flight, with the addition of temporary ballast if necessary.

This Change Proposal also includes (1) incorporation of an additional 514 cubic inch container in the ship's oxygen system which will provide an O₂ supply with adequate reserve for the longest refueling mission, and (2) installation of an electric driven submerged fuel boost pump with cockpit control switch. This will provide the pilot with optional back up for the existing hydraulic driven pump in the event of loss of hydraulic pressure or unsatisfactory fuel flow conditions.

To assure optimum utilization of the proposed IFR capabilities, consideration should be given to the following:

- a. Fuel Logistics: A problem may exist since the U-2C normally operated on LFLA or JPTS fuel, whereas the KC-135 normally operates on JP-4 (but is capable of using either fuel).
 - b. Rendezvous: Problems experienced in a trial rendezvous of a U-2C and KC-135 Tanker under ideal daytime conditions and using a 2-way radio communications indicate considerable difficulty may be encountered on actual refueling missions when attempting to rendezvous without use of homing facilities.
2. Modification of the aircraft (U-2C) to consist of the following:
 - a. Fuselage: Provide hole in structure at top centerline between F.S. 365 and 389, beef up structure locally and add mounting provisions for refueling Receptacle. Install vapor tight container to seal

NATURE OF PROPOSAL: (Cont.)

off vapors from engine section. To accomodate installation of a (refueling) fairing and maintain service accessability, relocate openings for the refig. coolant discharge, refig. regulator access, cabin air discharge louvers, oil tank filler, P-2 exhaust vent, and engine section cooling scoops. Install ducting as required by relocation of outlets and scoops.

Relocate upper navigation light to top of new fairing aft of Receptacle. Construct and install fairing to house refueling Receptacle and HF antenna tuner. Revise plumbing, wiring, and compressor bleed air duct in the upper engine section as required to avoid interferences.

- b. Fuel System: Revise plumbing arrangement to feed the main wing tanks into the left-hand (high level) sump tank, and the auxiliary tanks into the right-hand (low level) sump tank. Install refueling Receptacle Assy, (GFAE), disconnect pressure seitch, flow regulator, check valves, and connecting plumbing to right and left hand main wing tanks. Install shut-off valves and associated float valves with related plumbing in main wing tanks. Install electric driven fuel boost pump in R.H. sump tank with related plumbing. Replace chip catcher with 200 mesh strainer and install manual fuel shut-off between sump tanks and strainer.
 - c. Hydraulic System: Revise the hydraulic panel and install solenoid control valves and related plumbing to connect with the refueling Receptacle actuating cylinder and nozzle latch cylinder.
 - d. Cockpit & Electrical: Construct and install IFR control (switch) panel in L.H. console. Modify instrument panel by installing IFR system indicator panel in space presently occupied by the Magnetic Compass. This requires addition of new mounting provisions and relocation of the Magnetic Compass to the upper right periphery of the panel. Construct and install new instrument panel glare shields. Install refueling Receptacle Signal Amplifier in cockpit. Install fuel level float switches in L. and R. main wing tanks for indicating full and half-full conditions. Install wiring from cockpit to the refueling system fuel and hydraulic valves, nozzle receptacle, and tank mounted float switches. Install electric fuel boost pump control switch and related wiring.
 - e. Oxygen System: Install one additional 514 cubic inch oxygen bottle in the L.H. cheek with related mounting bracketry, valves, and plumbing.
3. No Service Bulletin required. All work to be performed at the factory on the basis of engineering drawings.
 4. This ECP does not include changes required to the KC-135 or installation of any electronic equipment for rendezvous.

GFAE EQUIPMENT LIST

<u>AF Stock No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Quantity Per A/C</u>
1560-652-0951	VM65350-14	Receptacle Assy.	1 Ea.
1560-341-6238	VM65395-21	Guide Assy	1 Ea.
1560-345-2541	VM65379-3	Shim (Cover)	12 Ea.
	VM38170-12	Cylinder Assy	1 Ea.
1560-345-2542	VM65382-1	Spring Assy	1 Ea.
1560-345-2538	VM65305-1	Strut Assy (Down Lock)	1 Ea.
1560-345-2537	VM65304-1	Strut Assy (Up Lock)	1 Ea.
1560-345-2536	VM65301-21	Torque Shaft Assy	1 Ea.
5306-625-5426	VM65309-1	Bolt (Stop)	2 Ea.
1560-345-2541	VM65379-2	Shim (Stop Bolt)	2 Ea.
1560-345-2544	VM65399-21	Bearing Support Assy	1 Ea.

The GFAE test nozzles listed below are required to ground check the aircraft refueling system. It is essential that a set of one each be supplied on a loan basis to the Contractor as soon as possible after start of aircraft modification. It is also recommended that a set of one each be considered for the using detachments.

<u>AF Stock No.</u>	<u>Part No.</u>	<u>Description</u>
4920-547-9016	VME500015	Nozzle - Test, Refueling
4920-587-4923	VM19607	Nozzle - Test, Electrical

ESTIMATED COST OF TWO INFLIGHT REFUELING KITS (SP-1918)

Design

Mfg. Assem. & Installation
 (Includes material & parts)

Flight Test

TOTAL PRICE SP-1918



STAT

SCHEDULE

1. Prototype - May 22, 1961
2. Subsequent Article - Depending upon availability of aircraft and workload. The modification, related estimates and schedule outlined in this proposal are based on the timely receipt of the GFAE Equipment listed in this ECP.

RECOMMENDED SPARES SP-1917:

The recommended spares are to be ordered by the depot on Purchase Order Requests. (Note: The spares listed below have been ordered to take advantage of price breaks).

<u>Part No.</u>	<u>Description</u>	<u>Qty.</u>	<u>Unit Price</u>	<u>Total Price</u>
14120-4	Valve - Hyd. Selector	4		
18140-2	Valve - Hyd. Selector	4		
1430D-22A-52	Switch - Pressure	8		
H-254	Valve - Press. Fueling (Make from 5-256-51)	8		
12257-29	Valve - Shut off	4		
2-153-101	Valve - Float	3		
6487	Limiter - Flow	3		
F73470	Switch - Float	6		
MH18D-26.5	Relay	4		
A20-1B	Amplifier	4		
A402P4SHB-4	Switch	4		
4TL1-3D	Switch	4		
R3315	Light Assem.	4		
9220-3620	Relay	6		
IHS35	Switch- Receptacle	8		
IHS7	Switch - Receptacle	8		
TOTAL PRICE SP-1917				

STAT

STAT

COST RECAP:

Total Price SP-1918
Total Price SP-1917

GRAND TOTAL PRICE

STAT